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1. Name of the Invention

Video Encoding and Decoding Device

2. Field of the Patent Request

(1) For the video encoding and decoding device consisting of encoding procession section where information of the input video signal is compressed, and decoding procession section where video signal is regenerated from the compressed information, in the encoding procession section are prepared the noise analyzing means to remove noise component from the input signal or to show parameters of the noise component;

(2) For the video encoding and decoding device where the mentioned noise component removal means and non-linear extraction means for extracting noise components from the input video signal are deducted in the circuit.

(3) For the video encoding and decoding device where noise analyzing means include representation of the statistically efficient parameters and means for statistical evaluation of the noise nature.

(4) For the video encoding and decoding device where the mentioned noise generation means generate noise with

statistical nature close to the noise originally contained in the extracted noise component of the video signal and add this generated noise via creating a circuit to the decoded video signal.

3. Detailed description of the invention

(Sphere of Application in Industry)

Actual invention refers to video encoding and decoding devices refers to encoding transmission of the digital video signal containing still image and moving picture and to encoding stocks, especially to the encoding procession devices compressing high-quality information, such as in high definition television signal, digital print images etc.

4. Existing Technologies

In video signals with high definition, like high definition television or digital print images the input digital video data contains a lot of noise, such as camera or film noises etc. In the encoding process of the high definition video signals, to reproduce noise component truly, a lot of information is necessary. For this aim the amount of information as a result of encoding must not be enlarged. When trying to have less amount of information, the noise component is not reproduced adequately, the not natural noises appear and quality lowers.

As a way to reduce amount of noise information, there's a way to erase noise component from the processed input video signal, according to Hirota Nogaki's "Examination of the HDTV encoding signal using corresponding comings and goings noise erase" (PCSJ88, pp.125-126), by processing before encoding noise erase, compared to when doing it without encoding, information amount can be 30% reduced. In this device, by performing noise erasing of the corresponding non-linear procession, due to

the pre-encoding both quality of the video is saved and amount of information is reduced.

(Problems to Solve by the Invention)

In encoding of video signal which demand high quality, it is necessary to be able to reproduce video the same as before decoding. If to the video signal was added camera or film noises and it becomes a part of the input signal, it becomes an important natural part of the video signal. Thus, in the video encoding process it is necessary to reproduce video signal with the noise components as it was before. But, in the method when erasing of the noise is performed before encoding, the encoded image becomes the smoothed from the noises unnatural video, and it is impossible to gain highly naturalistic video. It is impossible to completely erase noise component, and so when encoding noise component which wasn't erased, it is possible to identify unnatural noise.

Thus, to perform encoding of the high quality, it is necessary to reproduce noise component without increasing amount of encoded information. When we speak about natural reproducing of the noise component, it doesn't mean that it is necessary to statistically reproduce both nature and the waveform of the noise. It's because people can't distinguish difference of the waveforms. Thus, even with the little amount of information it is possible to perform efficient transmission and stock of information.

This invention, the video encoding and decoding device, by separating noise component from the input signal prevents the increase of information amount, transmits or stocks the noise component as a little amount of additional information and when encoding by statistically

reproducing noise component is able to gain high quality encoded image with the natural noise component.

(Means to Solve the Problem)

To achieve this aim, in the video encoding and decoding device consisting from encoding procession section where information compression of the input video signal is performed and decoding section regenerating video signal from the compressed information, the noise analyzing means are performed to express noise component with little parameters and noise separation means to erase noise component from the input signal, and also noise regenerating means to regenerate noise component from the parameters extracted in the encoding processing section.

The noise separation means contain means to extract noise contained in the input video signal by the non-linear processing and circuit deducting the extracted noise component to the input video signal.

The noise analyzing means contain means to evaluate statistical nature of the noise, and means to efficiently express little statistical parameters.

The noise regenerating means contain means for regenerating noise which would be close in its statistical nature to the noise component of the original signal, with help of the extracted statistical parameters, and a circuit connecting regenerated noise component to the encoded image signal.

(Operation)

Actual video signal decoding and encoding device separates noise component from the input video signal, then analyzes it statistically, turns it to parameters and transmits or stocks them. When encoding basing on the expanded little

parameters it reproduces statistically the noise component. Due to this, it is possible to avoid the enlarging of the encoded information related to noise component, and efficiently reproduce high quality video signal with original noise component.

(Operation example, basic structure)

Scheme 1 is the basic block scheme of the actual video signal decoding and encoding device. To the video input terminal 1 the digitalized video signal is input. The video input terminal 1 is connected to the noise separation section 2. In the noise separation section 2 noise component is separated from the input video signal, then the signal component 4 is output to the signal component encoding section 6, and the noise component 3 is output to the noise analyzing section 5.

The signal component analyzing section 6 is compressing information of the input signal component 4. As the information compression means different ways of encoding such as projected encoding or changing signal can be applied. In the encoding of the of the signal component 4 the noise can be erased and information can be highly compressed.

On the other hand, in the noise analyzing section 5 the statistical nature of the noise component is analyzed, and statistical parameters depicting it are extracted. As the example of parameters depicting statistical nature of the noise can be named signal power, correlation, fractal dimension etc. For depicting in statistical parameters noise component 3 less information is needed than for reproducing noise element with the waveform.

The signal component encoding section 6 and noise component encoding section 5 can both send or stock the output 7 which is the result of encoding procession. In the decoding device the results of the encoding procession of signal element 8 are input to the signal component decoding section 10, and statistical parameters 7 as result of the noise component encoding are input to the noise generating section 9. In the signal component decoding section 10 the signal component is generated. On the other hand, in the noise component section 9 basing on the statistical parameters the noise with the statistical nature close to one of the noise component contained in the video signal is generated. The generated noise component 11 is added to the results of signal component decoding in the noise adding section 13 and output as reproduced video signal. Due to this, the reproduced high quality video can contain noise element very close to the original one.

(Operation example of the noise separation section)

In the noise separation section 2 it is necessary to expand only noise component without changing form of the signal component or erasing it due to the non-linear processing.

Scheme 2 is the example of separating noise using non-linear filter. The input video signal is first input to the reduced passage filter 15. Then the difference between the filter output and input signal in the signal difference circuit 16 is calculated and it is input to the threshold value circuit 17. In the threshold value circuit 17, if the measure of the signal input to the threshold value circuit 17 is less than certain, this signal input to the threshold value circuit 17 is output as it is, and when it is more than the threshold value, the 0 output non-linear procession is applied.

The output of the threshold value circuit 17 is output as noise component. Due to using of the non-linear filter, even though the unexpected signal components such as edge exist, only the noise component is expanded.

Scheme 3 explains separation of the noise using direct right-angled exchange. The input signal due to the direct right-angled exchange circuit 19 (e.g. disperse cosine exchange circuit) is transformed to the frequency domain and input to the threshold circuit 20. In the threshold value circuit 20 according to the frequency ingredient if the size of the signal is less than threshold value, it is output as 0, and in other cases it is output as it was. The output of the threshold value circuit 20 due to the reverse transformer 22 is output as reverse-transformed signal component. And in the input video signal, the deducted signal component is output as noise component. Due to this action, only the components with certain standard frequency are output as signal component, and component with less frequency are expanded as noise.

(Example of noise analyzing section and noise generating section)

The noise analyzing section 5 consist of direct transforming circuit 19 and power evaluation circuit 24. The noise component separated in the noise separation section 2 is first transformed to the frequency domain in the direct transforming circuit 19, then the signal power according to each frequency component is searched in the power evaluating section 24. The value of each frequency is transmitted or stored as statistical parameter depicting noise component.

The noise generating section 9 consist of noise source 25, power control circuit 26 controlling size of the noise or reverse-transformer circuit 23. In the noise source 25 the white noise is generated. In the power control section 26 the size of the generated white noise basing on the statistical parameter 7 or each frequency power evaluating results the frequency component is controlled. In the reverse transformer 23, the signal of the frequency domain is transformed to the time domain and the noise component 11 is generated.

(Effects of the invention)

Due to this invention in the input video signal the noise component is separated by the non-linear procession, the noise component is analyzed, depicted in statistical parameters and basing on these parameters the noise is regenerated in the encoding device and this encoded signal is added to the video signal. Due to this the following is gained:

- (1) It is possible to reduce the information amount used for encoding
- (2) It is possible to express noise component contained in the original video signal with only few additional information
- (3) It is possible to gain the high quality video with natural noise effect.

4. Simple Explanation of the Schemes

Scheme 1 is the basic block structural scheme of the actual video encoding device,

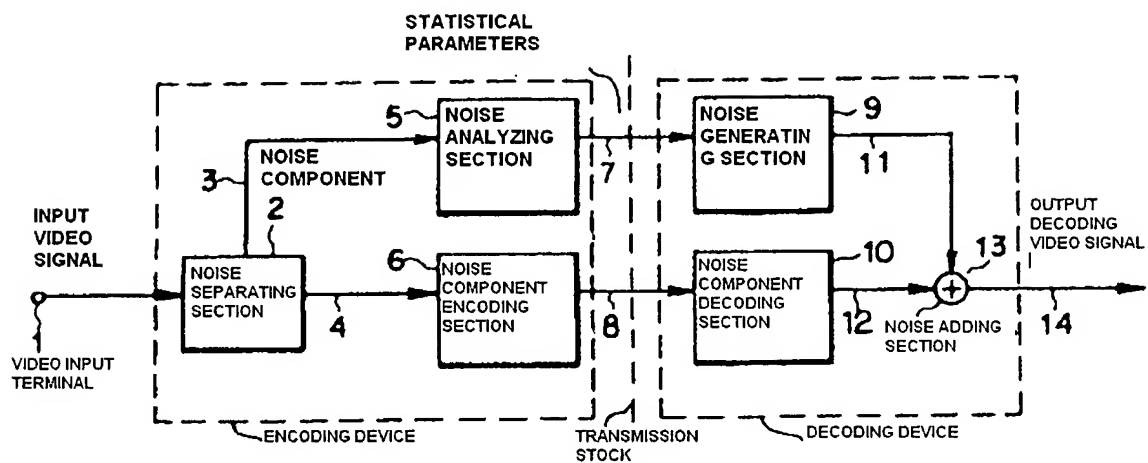
Scheme 2 is the block scheme which shows the structure of the noise separation with the non-linear filter,

Scheme 3 is the block scheme which shows the structure of the noise separation section with right-angled transforming procession,

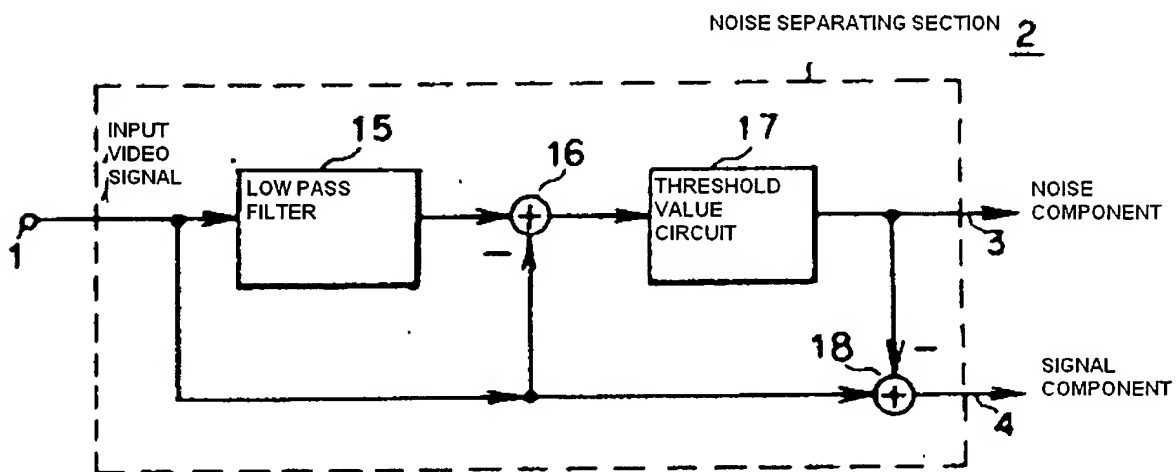
Scheme 4 is the block scheme showing the structure of the noise generating section and noise analyzing section with using statistical parameters of the noise power in the right-angled domain.

- 1 – video signal input terminal
- 2 – noise separation section
- 3 – noise component output
- 4 – signal component output
- 5 – noise analyzing section
- 6 – signal component encoding section
- 7 – noise parameters output
- 8 – noise component encoding procession result output
- 9 – noise generating section
- 10 – noise component decoding section
- 11 – noise output
- 12 – signal component output
- 13 – noise adding section
- 14 – video signal output terminal
- 15 – low pass passage filter
- 16 – signal difference circuit
- 17 – threshold value circuit
- 18 – signal difference circuit
- 19 – direct exchange circuit
- 20 – threshold value circuit
- 21 – signal difference circuit
- 22, 23 – reverse-exchange circuit
- 24 – power evaluating circuit
- 25 – noise source
- 26 – power control circuit

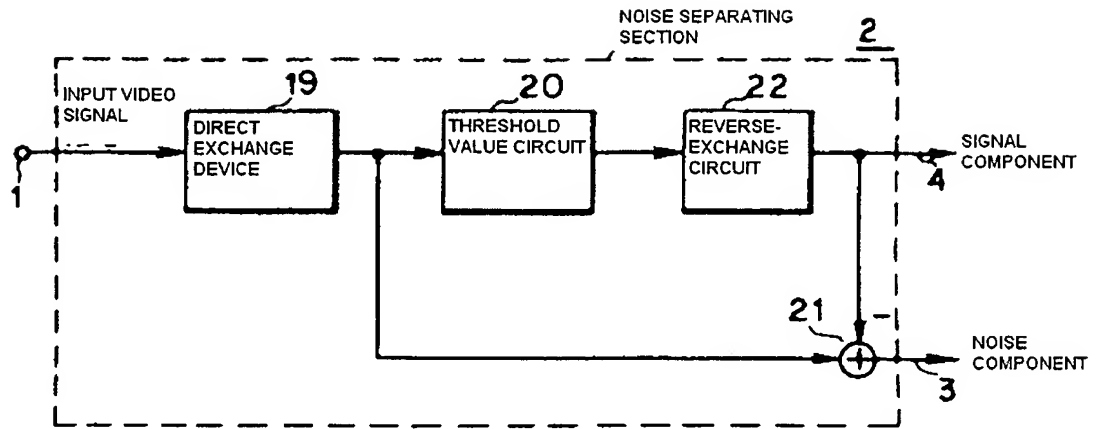
SCHEME 1



SCHEME 2



SCHEME 3



SCHEME 4

